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PROJECT COMPLETION REPORT

Sno	Item	Details
1	Project Number	5409
2	Title of project	Estimation Study for Reduction in Transport of Referral Cases to Tertiary Hospitals by Use of Mobile Enabled Telemedicine System in Remote Hospitals
3	Funding Agency Name	Mobilexion Technologies Private Limited
4	Project Reference Number provided by the Funding Agency	UMACS-Eval-SCT-IEC1
5	Principal Investigator (Name & Address)	Dr. Arun Gopalakrishnan, Dept of Cardiology, SCTIMST
6	Co-Investigators (Name & Address)	Dr. Abraham Kuruvilla, Dept of Neurology, SCTIMST Smt. S. Sudhamony, Chief Consultant, eHealth project, DHS, Govt. of Kerala
7	Implementing Institution	SCTIMST, Trivandrum General Hospital, Peroorkada Model Hospital
8	Collaborating Institutions	Nil
9	Date of commencement	18-7-2018
10	Duration	Six Months, Got delayed to two years
11	Date of completion	25-02-2021
12	Objectives as approved	This is Prospective Cohort study with SCTIMST, functioning as the Tertiary Hospital (TH) for two Remote Hospitals (RH) linking to it for telemedicine services for the referral cases. Objectives are: (1) RH gets an expert opinion without moving the patient to TH, thereby reducing patient discomfort and improving outcomes. (2) The patients get re-assured since there is clinical linkage with TH. (3) The main advantage for TH is that it can decide on admission without movement of patient, leading to better planning of resources. (4) The system also allows it to serve patients from geographically difficult terrains.
13	Deviation made from original objectives if any, while implementing the project and reasons thereof	Nil
14	Experimental work giving full details of summary of methods adopted, data collected supported by	See Annexure 1

	necessary tables, charts, diagrams and photographs	
15	Detailed analysis of results	See Annexure 2
16	Summary sheet of not more than 2 pages under following heads:(Title, Introduction, Rationale, Objectives, Methodology, Results, Translational Potential)	See Annexure 3
17	Contributions made towards increasing the state of knowledge in the subject	See item 20
18	Conclusions summarising the achievements and indication of scope for future work	The study shows that telemedicine is very useful for reducing the time of start of treatment and the cost of the providing specialized treatment. However, it is found that the clinicians in RH is not receptive to the idea. The main issue is that they are held responsible for the outcomes of the treatment directed by the clinicians in TH, in which they do not have much say. This is a major issue that need be studied in earnestness for arriving at a viable solution within the framework of the existing health care scenario in the state.
19	Science and Technology benefits accrued	See item 20
20	Abstract: (In 300 words for possible publication in ..... Bulletin)	Introduction: Patients, in many parts of the world, find that specialty hospitals are far away and commuting to them can aggravate the problem. Environments with limited access of patient-related information during decision-making and ineffective communication among patient care team members is a major cause for medical errors. It is well recognized that tele-medicine systems that replace commuting with communication is an ideal solution in such situations, provided it could be achieved without compromising the quality of communication. We have conducted a Prospective Cohort study with SCTIMST functioning as the Tertiary Hospital (TH) for two Remote Hospitals (RH) linking to it for telemedicine services for the referral cases. The primary objective of the study is to estimate the reduction in referral cases to tertiary hospital (TH) due to the usage of a telemedicine cart at the remote locations. Methods: The study involves one consultant from RH and two different consultants from TH for each enrolled case. A patient is enrolled when the consultant from RH decides to refer him to TH. The study proforma captures his diagnosis and treatment plan. After this, a telemedicine session is set up with the first consultant in TH who reviews the case and records his view on the diagnosis, treatment plan and the need for transportation to TH. The patient is transported to TH and is shown to the second consultant in TH who independently inspects him and records the final diagnosis. After this, he is shown the records of the previous two consultations and he records his view on whether the transportation could have been avoided after the telemedicine

		session. The patient continues under his care and the outcomes are monitored. Once enough cases are completed, we estimate the number of cases for which transportation could have been avoided as a percentage of total cases enrolled. Results: The analysis shows that in more than 90% of cases, the diagnosis and treatment plan arrived during the telemedicine session was not changed during the final consultation in TH. Discussion: Our findings reconfirm the advantage of interposing a telemedicine session with the TH before referring the cases there.
21	Procurement/Usage of Equipment	See Table 1

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Dr Arun Gopalakrishnan

(Name and Signature of PIs with date)

Table 1(a): Details of Equipment at TH

Sn	Name	Make /Model	Cost	Date of installation	Utilisation	Remarks on maintenance
1	VC System	Mobilexion	NA	1-7-2018	Utilised	Maintained by Mobilexion
2	Display Unit	50” TV	NA	-do-	-do-	-do-
3	Tele-Stethoscope	Tele-Stethoscope	NA	-do-	-do-	-do-
4	Online UPS	Online UPS	1	1	1	1

Table 1(b): Details of Equipment at RH

Sn	Name	Make /Model	Cost	Date of installation	Utilisation	Remarks on maintenance
1	UTM-101 Telemedicine Cart	UTM-101 Telemedicine Cart	NA	1-7-2018	Utilised	Maintained by Mobilexion
2	UTT-101 Telemedicine Trolley	UTT-101 Telemedicine Trolley	NA	-do-	-do-	-do-
3	LapTop to be kept in Nurse’s Duty Room	LapTop to be kept in Nurse’s Duty Room	NA	-do-	-do-	-do-

Part I – To be filled by Clinician in RH Prior to Telemedicine Session

Section I – Demography, Past History and Problems on Registration (To be filled by Nursing Staff)	
Demography	
Hospital Number	
Name	
Age	
Gender	
Mobile Number	
Address	
Occupation	
Monthly Income	
Educational Status	
Past History	
Diabetes Mellitus	
Hyper tension	
Coronary Artery Disease	
Chronic Liver Disease	
Chronic Kidney Disease	
Others	
Substance Abuse	
Smoking	
Alcoholism	
Pan	
Drug Abuse	
Others	

Physical Examination at Registration	
Height	
Weight	
Blood Group / RH	
Allergies	
Others	
Patient perspective of current problems during registration for current episode	
Major Complaints	
Past Episodes	
Current medication	
Section II – Record of the Current Consultation (To be filled by doctor at RH)	
Date and Time	
Name of doctor	
Temperature	
BP	
Pulse Rate	
Respiration Rate	
SPO2	
Major Complaints	

Part II – To be filled by Clinician in RH during Telemedicine Session in Consultation with TH Consultant

Sno	Item	Details
1	Interaction between patient and remote consultant	
2	Record of Vital Monioring	
3	Record of Auscultation with tele-stethoscope	
4	ECG Session	
5	Close Examination Camera Session	

6	Examination of Records	
7	Interaction between doctor and consultant	

Clinical Impressions and Plan for Management

8	**Need for transport to TH (in scale of 1-5)**	
9	**Name of consultant at TH**	
10	**Date and time**	
11	**Signature of doctor at RH**	

Part II – To be filled by Clinician in TH during Telemedicine Session in Consultation with RH Consultant

Sno	Item	Details
1	Interaction between patient and remote consultant	
2	Record of Vital Monioring	
3	Record of Auscultation with tele-stethoscope	
4	ECG Session	
5	Close Examination Camera Session	

6	Examination of Records	
7	Interaction between doctor and consultant	

Clinical Impressions and Plan for Management

8	**Need for transport to TH (in scale of 1-5)**	
9	**Name of consultant at RH**	
10	**Date and time**	
11	**Signature of doctor at TH**	

Part III – To be filled by Second Consultant in TH during Direct Session

Sno	Item	Details
1	Interaction with patient	
2	Record of Vital Monioring	
3	Record of Auscultation and impressions	
4	ECG Session	
5	Examination of organs	
6	Examination of Records	
Clinical Impressions and Plan for Management		

Part IV – Comparison Between Part II and III - To be filled by Second Consultant in TH

Sno	Item	Details
1	Interaction with patient	
2	Record of Vital Monioring	
3	Record of Auscultation and impressions	
4	ECG Session	
5	Examination of organs	
6	Examination of Records	
7	Interaction between consultant and patient	
Clinical Impressions and Plan for Management		
8	**Need for transport to TH (in scale of 1-5)**	
9	**Name of consultant at TH**	
10	**Date and time**	
11	**Signature of consultant at TH**	

Annexure 2
Detailed Analysis of Results

Table 1 gives an overview of the sample data set collected.

Table 1 – Overview of the Sample Data Set

Item	Value
Population Size	28
Females	19 (68%)
Age Range	19-85
Average Age	54
Std. Dev. Of Age	16
Monthly Income Range	200-10000
Monthly Average income	1130
Std. Dev. Of monthly income	1731
Period of Enrolment	24-7-18 to 2-2-19
Enrolment per month	1-6
No. of deaths	1
No of cases that didn't improve	2
% of cases where final diagnosis was different from that during telemedicine	0

The size of data set collected was 28. The ratio of females to males was 68:32 indicating a skew in the sample. This would be more evident when we consider the monthly income range of the participants which stans at Rs 1130/-, far below the average income of general population in the area being covered by the study. This indicates the study covered only the downtrodden strata of the society. A possible explanation for this is that, since private practice is allowed in the hospital, the clinician in the RH may not be interested in enrolling wealthier cases.

The period of data collection was about six months (August 2018 to January 2019). The total monthly enrolment varied from 0 to 8. The average enrolment was only 4. Considering that there is normally an overcrowding of patients in the OP counters in this hospital, such a low average indicates lack of interest from the ground staff. The possible reasons for this are explained below:

- GH handles all type of cases and the study considered only neurology. The percentage of the total cases stamped as neurology in the OP desk was very small. On days in which the neurology doctor was not on duty (for example – most part of September), such cases were referred to other doctors and they were not aware of the requirement of conducting telemedicine before referring the cases to treasury hospital.

- GH generally refers the cases to Trivandrum Medical College (TMC). There is a long-standing relationship between the doctors in the two entities. The treatment in TMC is free for those below poverty line (in SCTIMST the cost of procedures and lab tests are borne by the patient). This leads to a genuine reluctance in the mind of the RH consultant to refer the patient to SCTIMST.

- The synchronisation of operations from the two different locations essential for proper running of the Video Conferencing was another challenge. In many cases, when the doctor in RH is ready for examining the case, the one at TH is not ready, and vice versa. This results in ego clashes between them jeopardising the entire project.

- Starting the operations from the second RH was another challenge. The first RH and the office of DHS were in the same building and it was relatively easy to resolve administrative issues relating to DHS. Not so for RH2. Even after the whole system was made fully ready there, the doctors didn't enrol any case citing non-receipt of directions from DHS (even though the same study had already progressed over three months in RH1, which also was under DHS).

Most of the cases referred are connected with stroke. It is seen that the recovery was more than 90%.

In all cases, the diagnosis on direct examination by a second independent consultant in TH confirmed the diagnosis during the teleconsultation. This result has far-reaching implications, when we consider the savings due to it in remote locations like Idukki, Wayanad, Lakshadweep, etc. Therefore**, it may be worthwhile to repeat the current study in a more elaborate fashion as a precursor for introducing teleconsultation as a mandatory step for admission to a treasury hospital.**

Annexure 3
Summary Sheet

Title: Estimation Study for Reduction in Transport of Referral Cases to Tertiary Hospitals by Use of Mobile Enabled Telemedicine System in Remote Hospitals

Introduction: Telemedicine refers to the use of ICT to provide remote clinical services. It is estimated that half of U.S. hospitals employ it in one form or other. Initial studies on cost benefit analysis indicated huge savings in transportation and manpower costs. Many hospitals in India established telemedicine networks in the last decade. Even though these systems are still operational, the usage hasn't picked up and the Indian telemedicine segment remains miniscule. It is quite conceivable that the cost savings due to technological solutions in one region doesn't translate into corresponding savings in another, due to differences in operational environment. Previous studies on cost savings used presumptive computation based on number of actual telemedicine visits. This inflates the estimate of the savings, since most of them were unnecessary and would have been avoided, in the absence of telemedicine. Moreover, the cost of clinical mis-judgment due to usage of the technology was not considered. Thus, there is a need for a carefully planned controlled study, to determine the actual savings due to the usage of the telemedicine system in the local context. The current study was aimed at this.

Rationale: Recognizing the potential of the telemedicine technology, many hospitals in India established telemedicine networks in the last decade itself. These interconnected the main hospital with its peripheral centres with video conferencing using satellite communication. Tele-pathology and tele-radiology equipment were interfaced to this system. Consultation hours were marked off each week where the doctors in main hospital will be present in the teleconferencing room to attend to cases from the remote hospitals. Over the years, this system became the de-facto standard for telemedicine systems in India. However, even though these systems are still operational in many locations, the usage hasn't picked up.

The root cause of the failure in scale-up of the above system is architectural. The major lacuna is that video-conferencing is made pivotal to its operations. This necessitates specially constructed rooms to provide the required quality for video conferencing. Telemedicine operation is made a distinct activity to be scheduled and executed as a separate item in the operational workflow for the various clinical departments. Due to the high load on the senior consultants, they find it difficult to come to the telemedicine room as planned. This results in cancellations and/or delays. Communication problems with the remote site also delays the sessions. The organizations end up owning a system with high set-up and maintenance cost and erratic in operations. The outcome was unsatisfactory for most stake holders.

The Ubimedique Acute Care System used in this study was developed to bridge the above gap. The main objective of UMACS is to make the tele-medicine operation ubiquitous to the clinicians at both ends. It should operate seamlessly all the time for all stakeholders. The advances in mobile and cloud computing technologies and the prevalence of smart phones across the clinical community make this possible at a fraction of the cost of the earlier systems.

The current study was for arriving at an unbiased estimate of the reduction in the transfers to tertiary hospitals using such a set up in the Indian Govt. health-care scenario. Such a study was not conducted before.

Methodology: The study involves one consultant from RH and two different consultants from TH for each enrolled case. A patient is enrolled when the consultant from RH decides to refer him to TH. The study proforma captures his diagnosis and treatment plan. After this, a telemedicine session is set up with the first consultant in TH who reviews the case and records his view on the diagnosis, treatment plan and the need for transportation to TH. The patient is transported to TH and is shown to the second consultant in TH

who independently inspects him and records the final diagnosis. After this, he is shown the records of the previous consultations and he records his view on whether the transportation could have been avoided after the telemedicine session. The patient continues under his care and the outcomes are monitored. Once enough cases are completed, we estimate the number of cases for which transportation could have been avoided as a percentage of total cases enrolled.

Results: The analysis shows that in more than 90% of cases, the diagnosis and treatment plan arrived during the telemedicine session was not changed during the final consultation in TH.

Translational Potential: This study was initiated about two years before the onset of Covid-19 pandemic. During that time, there was a Bombay High Court verdict against a doctor couple alleging medical negligence due to usage of telemedicine in their practice. Many doctors interpreted the judgment as deeming that telemedicine practice is illegal.

The onset of the pandemic changed the scenario. Government of India released telemedicine practice guidelines for Registered Medical Practitioners on March 25, 2020. It also brought out the Sanjeevani Telemedicine System for virtual consultation. Thus, currently, there is no doubt in the healthcare industry that the practice is legal and beneficial.

However, there is a lot of misunderstanding on how to use the technology within the current scenario of the Government hospital chain of medical colleges, district hospitals, Taluk hospitals and PHCs spread throughout the state. The PI had met the health secretary Govt. of Kerala with the proposal that telemedicine could be made an integral part of this chain. The idea was to start from the top by giving a direction to the remote hospital making is mandatory to have a teleconsultation with the treasury hospital before referring a case there. This would reduce the incidence of such reference drastically. The suggestion was kept for consideration for a later date and the Covid years created a vacuum in decision making. This would be the right time to re-visit this decision and come out with a comprehensive plan to implement it.